



The socioeconomic impact of seismic events on animal breeding. A questionnaire-based survey from central Italy

Francesco Pagliacci^{a,*}, Cristina Luciani^b, Margherita Russo^c, Fulvio Esposito^e,
Annette Habluetzel^d

^a University of Padua, Dipartimento Territorio e Sistemi Agro-Forestali (TESAF) and CAPP (Research Centre for the Analysis of Public Policies), Italy

^b Istituto Zooprofilattico Dell'Umbria e Delle Marche "Togo Rosati"; Umbria Regional Offices, Direction for Health and Welfare - Services for Prevention, Veterinary Sanitation and Food Safety; Perugia, Italy

^c University of Modena and Reggio Emilia, Department of Economics "Marco Biagi" and CAPP (Research Centre for the Analysis of Public Policies), Italy

^d University of Camerino, School of Pharmacy, Camerino, Italy

^e University of Camerino, Professor Emeritus; Camerino, Italy

ARTICLE INFO

Keywords:
Earthquakes
Inner areas
Animal husbandry
Building back better

ABSTRACT

This paper investigates the socioeconomic impact of two large earthquakes (1997 and 2016) that occurred in Central Italy on the agricultural sector, and in particular on animal husbandry. Through a questionnaire-based field survey, involving 55 farm holdings located in Umbria (Assisano district), this work points out: i) the farmers' perception of the damage suffered with regard to residential buildings, agricultural facilities and animal husbandry activities; ii) the interventions carried out in the emergency phases; and iii) the reconstruction phases, as experienced by the farming households. Major vulnerabilities of these agricultural holdings have emerged: small-scale family-based farming, increased householders average age, little on-farm and off-farm diversification, persisting economic marginalisation. Recall and perception of the impact of the earthquakes in the Assisano district - direct damage and reconstruction interventions - are compared with the perception in the nearby mountainous area of the Marche Region, largely affected by the 2016 earthquake. In both areas, the experienced earthquakes have not acted as triggers for agents' mobilisation and change. Rather, the situation calls for a drastic, farsighted change of development policies by national and regional governments and for a convinced prompting for holistic local "building back better" initiatives.

1. Introduction

As many other countries in the South-Eastern part of Europe, Italy is exposed to earthquake hazard, as the main fault lines in Europe are located under the Mediterranean Sea. Italy is characterised by many tectonic faults, which frequently produce both moderate (usually, with $M < 5$) earthquakes, but periodically strong and destructive earthquakes ($M > 6$) [1,2]. When strong earthquakes occur in rural areas of Italy, the agricultural sector – and in particular animal husbandry – is severely impacted. Not only buildings, but other socio-economic assets are hit, producing widespread destruction and suffering in communities.

This is the case of the Umbria Region, in Central Italy. This region is located at the foot of the Apennine mountain range and is largely rural, as other seismic zones across Italy. The rural traits and fragile socio-economic structure of this region emerge as a critical feature in the

case of a severe earthquake. As stressed by Sanders et al. [3]; the impact of natural disasters is generally magnified in rural communities, because of lower availability of financial, infrastructural and human capital resources, and a reduced capacity to cope and adapt to adverse events [4]. In other words, they are particularly vulnerable to adverse events. The concept of vulnerability – together with the entwined idea of resilience – represents a key policy concept, which has experienced a meteoric rise in popularity in disaster research since the 1990s [5]. According to the definition provided by Wisner et al. [6]; vulnerability refers to all those physical, social, economic and environmental factors that may increase the susceptibility of individuals, communities, assets or systems to the impacts of hazards [7,8]. Thus, it encompasses material fragility, on the one hand [9] and social weaknesses on the other [10–13].

In the case under analysis, social vulnerability represents a critical issue. It is mostly driven by depopulation, and production related

* Corresponding author.

E-mail address: francesco.pagliacci@unipd.it (F. Pagliacci).

<https://doi.org/10.1016/j.ijdr.2021.102124>

Received 26 August 2020; Received in revised form 9 February 2021; Accepted 9 February 2021

Available online 17 February 2021

2212-4209/© 2021 Elsevier Ltd. All rights reserved.

restrictions of local communities [1,14]. The rural areas of Central Italy are frequently remote, and their social vulnerability is aggravated by the fact that they are surrounded by other vulnerable municipalities [15]. Moreover, the long series of earthquakes that have occurred over the last decades have not significantly altered the general conditions of the area; vulnerability has remained a persistent and critical trait of those communities. In Central Italy, it seems that earthquakes have not acted as triggers for agents' mobilisation and change, as experience in other settings shows [16]. In fact, despite human losses and extensive damage to infrastructures and buildings, there is evidence that major catastrophic events may become the leverage for long-term strategic policy changes [17,18], prompting a proactive form of resilience [19]. Resilience as a term is generally adopted in the contexts of resistance and adaptation to economic shocks, climate change, and environmental disasters [20]. With regard to community resilience, this notion is grounded on the idea that if a local community is endowed with material (e.g. infrastructures, economic activity) and immaterial resources (e.g., a local leadership or relational capital), these features might enable it to cope with changing circumstances [21]. However, different interpretations exist. While the dominant discourse on resilience of local communities focuses on the idea of bouncing back from external shocks (ecological resilience), lately a proactive approach has emerged, suggesting that local communities may adapt to new equilibria with reduced vulnerability after an exogenous shock (adaptive resilience) [19]. In the case of rural communities, proactive resilience can emerge when people feel they "belong to a place, a community and a citizenry" [21]: 22). Under these circumstances, actions effectively take place.

In the case of Central Italy, it appears that adaptive resilience fails to emerge. Rather, the perception is that earthquake recovery is limited to the reconstruction of buildings and physical infrastructure, without any role for community resilience as a leverage for recovery and change. This paper aims to investigate this issue, with a focus on the agricultural sector and animal husbandry, affected by the latest (i.e., in 1997 and in 2016/2017) severe earthquakes in the area. Thus, it is of interest to illustrate and analyse the farmers' perceptions of the damage suffered in terms of effects on agricultural and animal husbandry activities, by comparing both events. Damage was mostly suffered from the destructive effects on residential houses, stables and other farm buildings. Moreover, the study aims to highlight the interventions carried out in the emergency phase, as well as in the reconstruction phases, as experienced by the farming households. The study also collects information on future paths of development, having gathered data on farmers' needs and ideas for intervention, in order to ensure profitable and sustainable livestock activities in the future. This analysis allows some hypotheses to be made on the causes of social vulnerability and lack of resilience in this area and suggests policy measures to enhance communities' resilience in earthquake-prone areas (or communities).

Specifically, this empirical analysis focuses on the Assisi area, in Umbria Region, by comparing the effects on the socio-economic, productive and market conditions of livestock farms, produced by the latest severe earthquakes that occurred in the area, in 1997 and in 2016/2017. Both were characterised by a long series of tremors. Accordingly, the specific objectives of the study are to:

1. assess the socio-economic characteristics of cattle, sheep and mixed farm households, typical of the Assisi area;
2. analyse the farmers' recall and perception with regard to both the direct and the indirect effects caused to breeding activities (e.g., damage to residential houses, livestock and agricultural structures), by both earthquakes;
3. collect farmers' experiences on the support obtained as a response to the emergency, on their needs and ideas for intervention, in order to formulate suggestions to improve emergency and reconstruction phases governance.

2. Study area

2.1. The Assisano district: socioeconomic and geographic features

The study focusses on the area covered by the Assisano District of the USL Umbria 1, namely the local section of the National Health System.¹ While the USL Umbria 1 covers a large part of the province of Perugia, the Assisano District includes only five municipalities: Assisi, Bastia Umbra, Bettona, Cannara and Valfabbrica. As shown in Fig. 1, these municipalities are close to the regional capital (Perugia), although they are mostly rural. There are only two larger towns (Assisi and Bastia Umbra, each of them with more than 20,000 inhabitants), while the other municipalities have less than 5000 inhabitants each. Also, urban settlements cover a limited share of the total area of each municipality. Morphologically, these municipalities are mostly hilly. Their town centres are mostly located on hilltops, with the exceptions of Bastia Umbra and Cannara, whose town centres are in flat areas at the bottom of the valley. However, Bastia Umbra is the only municipality whose municipal boundaries are entirely located in the flatlands. The others are mostly hilly, being above 300 m above sea level (Fig. 1).

With regard to the social features of these municipalities, they share the same pattern as other Italian rural municipalities where population ageing has been coupled with increasing inflows of foreigners since the early 2000s. In 2018, the share of people aged 65 and over was around 24% in the municipalities under analysis, while 10% were foreigners (Table 1). According to the ISTAT [23] data, the five largest groups of foreigners are from Romania, Albania, Morocco, Ukraine and Poland.

With regard to the economic characteristics of the area, it shows some peculiar traits. As the birthplace of St. Francis in the late 12th century, Assisi has always been an important religious destination for pilgrimages in Europe. Accordingly, tourist accommodation has always represented a key part of the local economy. Religious tourism combines with artistic tourism, also thanks to the fact that, in 2000, UNESCO designated the Franciscan structures of Assisi as a World Heritage Site.

Despite the importance of the tourism, since the 1970s, the area has suffered from long-term changes. While the population has steadily grown, as a consequence of the counter-urbanisation process affecting several small towns next to larger urban areas, the overall increase in employment has been astonishing. Total employment in local establishments (i.e., the number of workers employed by local establishments operating in the five municipalities²) has soared from less than 10,000 in 1971 up to 19,133 in 2011. This increase was particularly high in the 1970s and 1990s, following a sort of industrial take off, which characterised a larger area across North-Eastern and Central Italy in that period [24]. In particular, in terms of both population and employment growth, the area has out-performed the rest of Umbria (see Fig. 2a and Fig. 2b), although it has shown heterogeneous trends. The population and employment rise has been particularly significant in the flatland municipalities next to Perugia, while smaller and more mountainous municipalities did not benefit from population overspill from the city. The municipality of Valfabbrica – i.e. the most mountainous one among the five studied here – actually experienced an overall decrease in total population in the timespan under consideration [23].

With regard to agricultural activities, they mostly occur in the hilly and mountainous municipalities. In general, the agricultural area has faced a sharp reduction of about 20% in 30 years, and in this case the trend is rather homogenous and in line with the rest of the Region [23]. However, two municipalities (i.e., Bastia Umbra and Cannara) experienced a reduction of approximately 40% of the agricultural area. Being located in the flatlands and closer to Perugia, they suffered a greater urbanisation process (Fig. 2c). With regard to the structural

¹ USL stands for Unità Sanitaria Locale, i.e. a Local Health Authority.

² The workers employed in local establishments are considered disregarding the municipalities where they live.

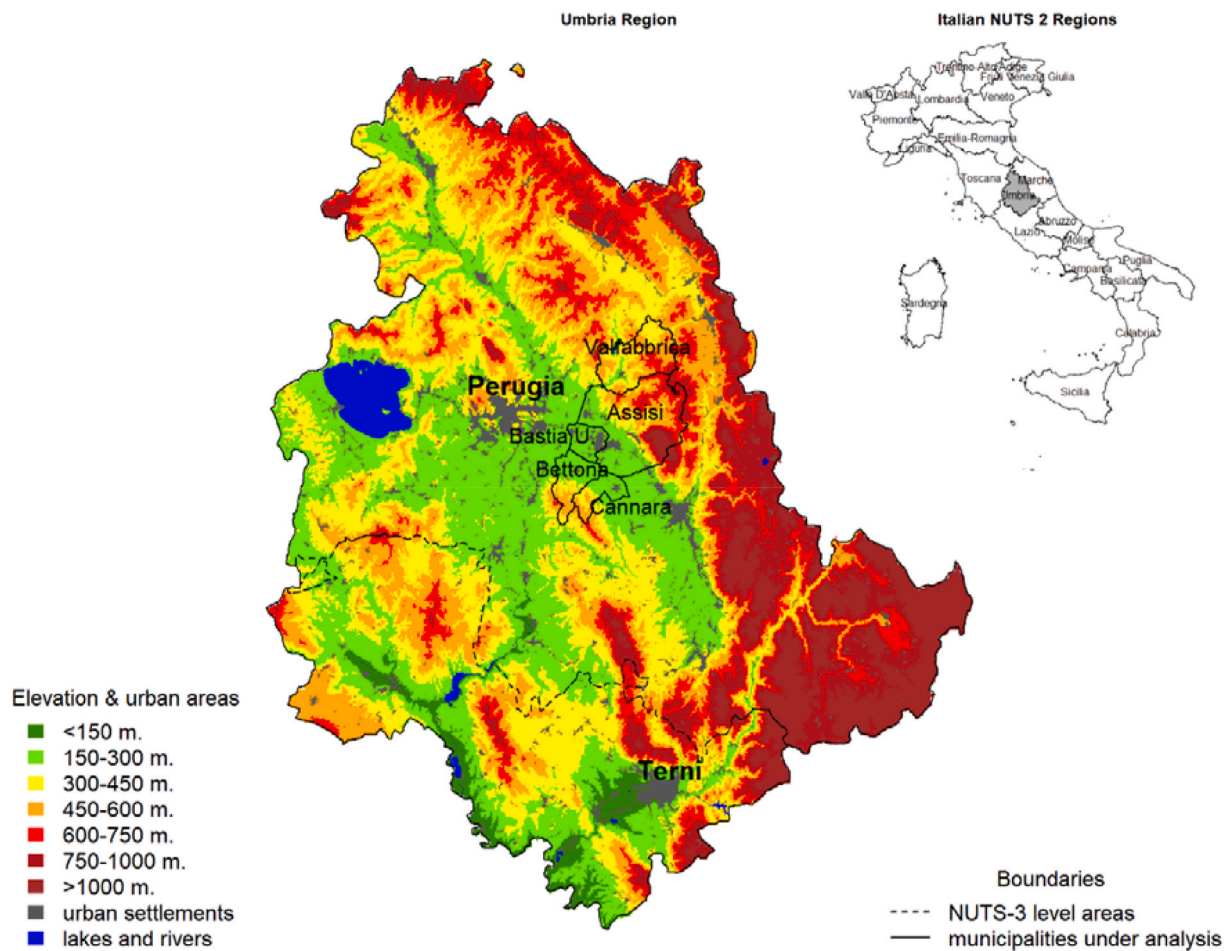


Fig. 1. The municipalities of Assisi, Bastia Umbra, Bettona, Cannara and Valfabbrica, in the context of Umbria Region (large picture). Umbria Region in the Italian NUTS 2 regions context (smaller picture). Source: authors' elaboration. Data on elevation are elaborated on Tarquini et al. [22] data.

Table 1
 Characteristics of the area: surface, population and employment. Source: authors' elaboration on ISTAT [23] data.

	Area (km2)	Altitude a.s.l. (m) of the town center	Area of the municipality above 300 m a.s.l. (% of the total municip. area)	Population (2018)	Foreigners (% of the total)	Persons aged 65 + (% of the total)	Employment in local establishments (2011)
Assisi	187.2	424	64.93	28,352	10.7	24.3	8446
Bastia Umbra	27.6	202	0.00	21,773	10.3	21.2	7785
Bettona	45.1	353	43.03	4357	10.8	22.5	1234
Cannara	32.8	191	41.48	4337	10.4	23.0	922
Valfabbrica	92.3	289	93.26	3402	9.6	26.5	746
NUTS-3 regions (province)							
Perugia	6337.2	–	–	657,786	11.0	24.6	189,006
Terni	2127.2	–	–	226,854	10.2	27.0	60,156
NUTS-2 regions (regioni)							
Umbria	8464.3	–	–	884,640	10.8	25.2	249,162

characteristics of the farming sector in the studied area, it is worth noticing that the share of large agricultural businesses is quite small.

To a certain extent, and despite the flourishing of both industrial and tourist activities, in the last decades the study area has followed an evolutionary path common to other 'inner areas' in Italy, as defined by the Italian National Strategy for Inner Areas (henceforth, SNAI, its Italian acronym) [25]. This concept resembles the label of 'deep rural', originally suggested by Lowe and Ward [26]. Being remote and rural, inner areas suffer from a lower availability of essential services (education, health and mobility, according to the Italian SNAI), hence they lack those resources and facilities needed to attract new incomers

and/or commuters to towns. As a major source of marginalisation for these areas, it is easy to point out the so-called "backwash effects", caused by the process of circular and cumulative causation [27]. But, remoteness and lack of services affect local communities also in case of an adverse natural event. Thus, they are becoming more and more vulnerable and hence less resilient to adverse events. Accordingly, several European and North American governments have shared similar fears about the socioeconomic and demographic fate of small rural towns [21].

In this specific case, Assisi, Bettona and Valfabbrica are classified as inner area municipalities, whereas Bastia Umbra and Cannara are less

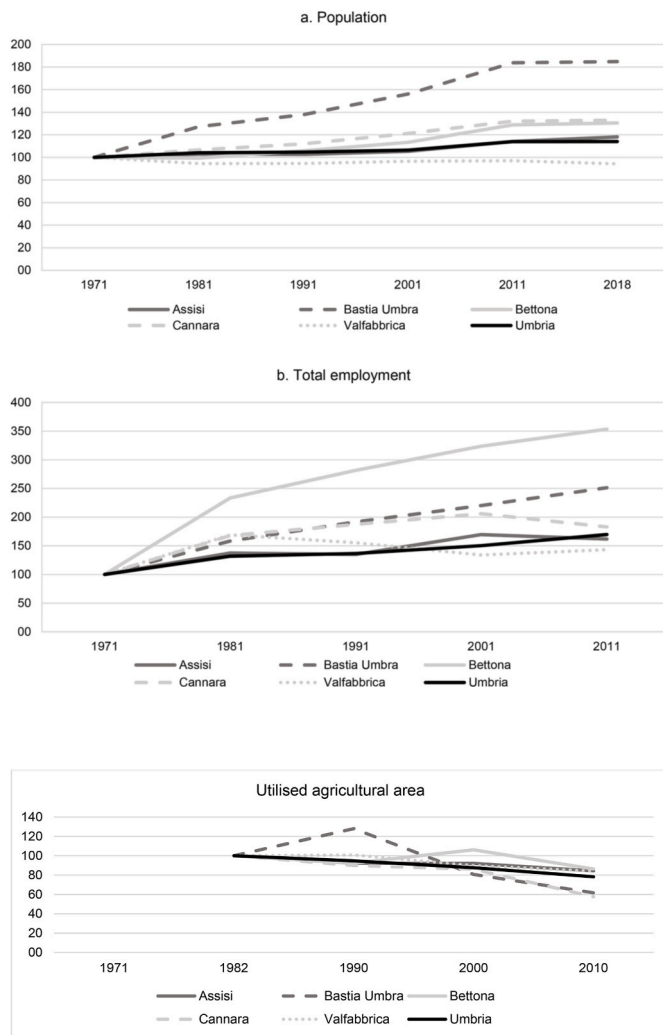


Fig. 2. Trends of population, total employment (agriculture + mining, manufacturing and construction + tertiary activities) and agricultural area, by municipality (years 1971–2018). Index numbers are reported on the y-axis. Year 1971 is the base value (equal to 100) and following amounts are weighted accordingly. For utilised agricultural area, year 1982 is considered as the base value. Source: authors’ elaboration on ISTAT [23] data.

marginal, being located in closer proximity to Perugia and benefitting from counter-urbanisation processes and greater availability of essential services in their surroundings.

Despite these long-term trends, agriculture and livestock farming (cattle, sheep and pigs) are still a key component of the local economy in the Assisano district, together with industrial activities. Crafts and tourism are also important, given the presence of the town of Assisi.

As far as agricultural activities and livestock farming are concerned, most of the farms raise more than one species of animal (sheep and goats, cattle and pigs, sheep and pigs, ...). According to the available data from the national Identification and Registration Database (*Sistema Veterinario Nazionale*), there are 358 active cattle farms and 573 active sheep farms in the Assisano district. In the period from 1997 to 2017, 68 cattle farms and 32 sheep and goat farms were newly registered, while 87 cattle farms and 65 sheep and goat farms closed. Conversely, poultry operations are very limited in the area.

2.2. Major earthquake activity in the area

The Assisano district is located at the foot of the Apennine mountain range. The Umbria-Marche Apennines are largely affected by intense

Plio-Quaternary extensional deformations. Mainly SW-dipping normal and normal-oblique faults, with associated intramontane basins, are the main expression of the extensional strain field at the surface. This phase is still ongoing, affecting the area with a SW-NE-striking extension [28] and this extensional tectonic regime drives numerous active faults, as well as the related seismicity, in this part of the Italian territory.

Since the 1980s, several earthquake events have affected Umbria Region (including the Assisano district). First, on April 29, 1984, an earthquake with M_w 5.6 had its epicentre between Perugia and Gubbio. Second, on September 26, 1997 two earthquakes with M_w 5.7 and 6.0 were located in the area of Colfiorito (at the border between Umbria and Marche). Both the 1984 and 1997 earthquakes had their epicentres located quite close to the Assisano district (i.e. <30 km). They thus caused widespread damage to the area. For example, the 1997 earthquake caused the collapse of parts of the Basilica of San Francesco in Assisi.

Lastly, also the severe and very long series of earthquakes striking Central Italy, starting in August 2016, affected the Assisano district. Although these earthquakes had their epicentres located at greater distance from the area, their magnitude was so high that the effects on the Assisano district were also severe. The 2016 series of earthquakes was formed by nine major shocks M_w 5+: in particular, on August 24, 2016, an earthquake with M_w 6.0 occurred in the area of Accumoli and Amatrice (Lazio); then, on October 30, 2016, an earthquake with M_w 6.5 occurred close to the town of Norcia, located on the border with the Marche Region [29].

Fig. 3 maps the epicentres of the largest earthquakes in 1984, 1997 and 2016. The interview study carried out in this work focuses on recalling the effects of two more recent ones (1997 and 2016).

3. The survey

A questionnaire-based field survey through face-to-face interviews was conducted, according to the methodology already applied in a previous study focusing on the impact of the 2016 earthquake in the Marche Region, as part of the project “Nuovi sentieri di sviluppo dell’Appennino marchigiano dopo il sisma del 2016” (in English, New paths of development for the Marche Apennines after the 2016 earthquake) [30].³ In brief, a semi-structured questionnaire was administered by veterinarians operating in the area (both of the public health service and private practitioners) to farm households. Several questions gathered quantitative information about the characteristics of the livestock holdings and damage suffered by the earthquakes. A wide section of open questions was also included, to address the farmers’ perceptions about the last two large earthquakes, the current support received in the emergency phases and their ideas about the future of their own holdings and of their communities. In detail, the questionnaire included the following sections:

- Characteristics of the livestock farms: socio-demographic data of farmers’ families and sources of income;
- Characteristics of animal husbandry: species (types of production) and number of animals raised;
- Damage to residential and farm buildings (in the aftermath of the earthquakes);
- Perception of disaster management (in the emergency phases);
- The future of the reconstruction: perception about the future and ideas for improving economic activities.

Sections of the questionnaire included references to both the 1997 and 2016 earthquakes allowing for comparison of the two events. The

³ The structure of the questionnaire was developed in collaboration with researchers from the Department of Economics “Marco Biagi”, University of Modena and Reggio Emilia.

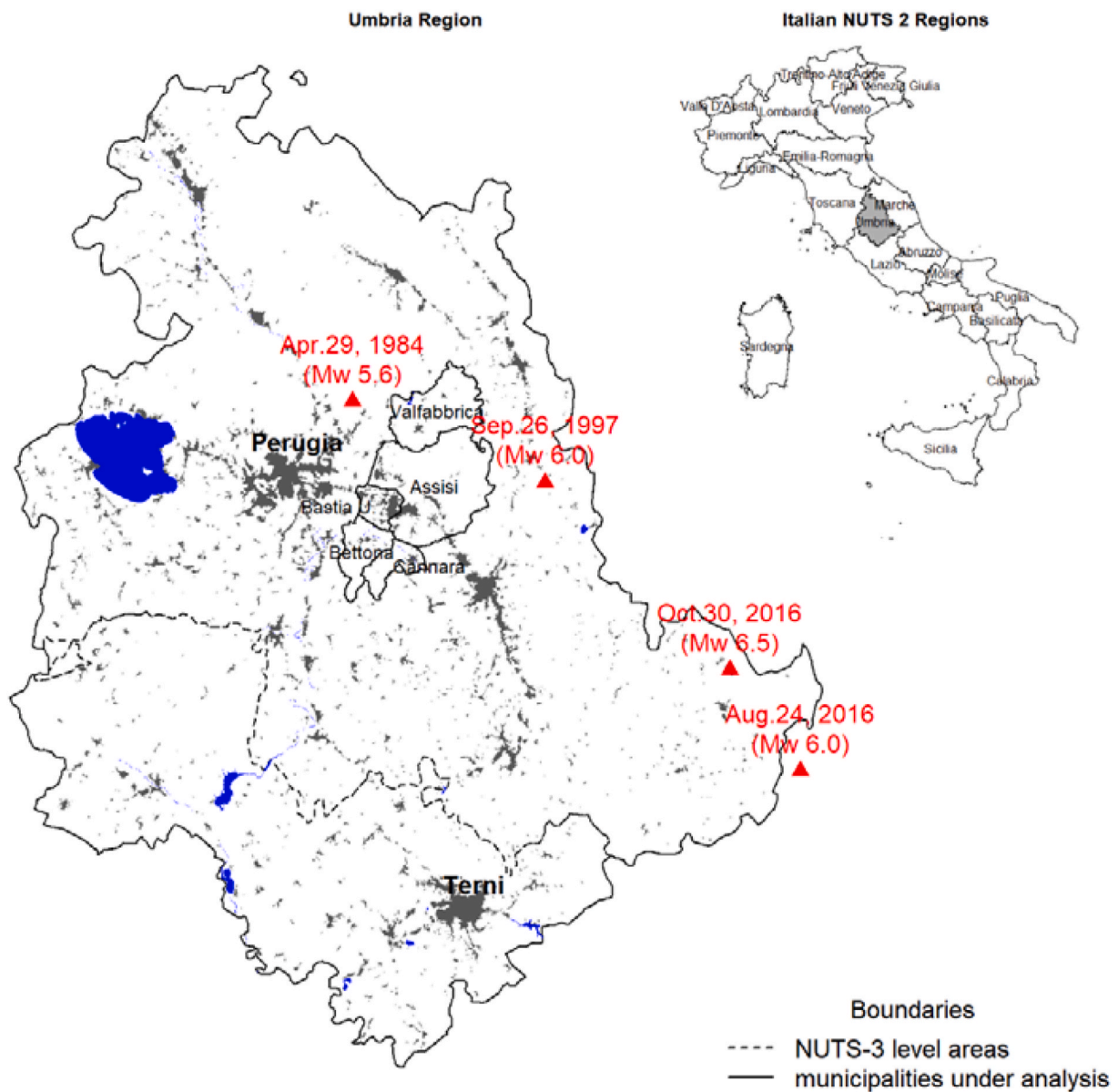


Fig. 3. The study area and epicentres of the major earthquakes considered here (larger picture). Umbria Region in the Italian NUTS 2 regions context (smaller picture).

interview study was organized in collaboration with veterinarians of the Assisano health district (USL Umbria 1) and private veterinary practitioners of the area, thanks to whom it was possible to enrol farm households likely to have a memory of both earthquake events.

4. Results

4.1. Characteristics of the livestock farms

Socio-demographic characteristics of farmers' households: A total of 55 questionnaires were administered to the heads of households (44), to their wives (8) or other close relatives (3) during the interview study conducted in the second half of 2017 and first months of 2018. Most of the interviews were held with farm households situated in the Assisi municipality (40), while eight were held in Valfabbrica, five in Cannara and two in Bettona. Albeit part of the Assisano district, no farmers could be involved from Bastia Umbra in the survey.

In this area, typically, animal husbandry is run as a family-based economic activity, remaining at a small scale. The large majority of

farm "households" count less than 6 active members (including both family members and wage-earning workers), when considering both 1997 and 2017 (Fig. 4). Little more than one fourth of farm households resorted to wage-earning workers (14 and 15 out of 55, in 1997 and 2017 respectively). Only one household in 1997 and two in 2017 counted more than 15 members (including also wage-earning workers), and can be considered business enterprises. Households with only two members increased from 10 in 1997 to 25 in 2017, reflecting the trend of exodus of the young generation, leaving their parents behind. This phenomenon has become common in the last decades, especially across Italian inner areas [25]. Similarly, the medium age of the heads of household was 55 in 1997 and increased to 66 in 2017.

Analysing household members by gender, it emerges that the proportion of women amounts only to 34% in 1997 and 29% in 2017, indicating a stronger tendency of women abandoning the farmers' life rather than men.

Income generating activities: A consistent proportion of farmers' households rely exclusively on income earned from animal breeding and from selling animals, their meat or milk. This was the case for 46 out of

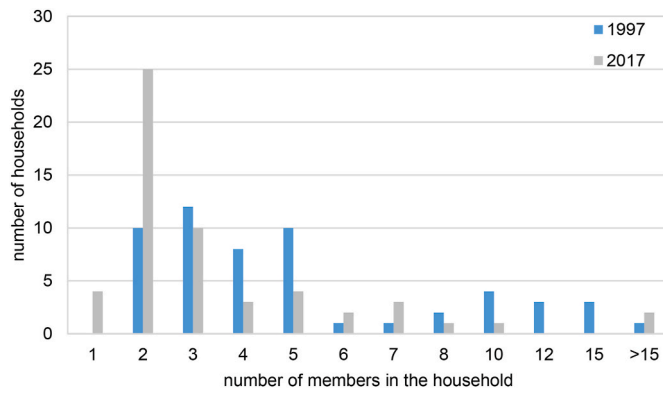


Fig. 4. Size of farmers’ households (including both family members and wage-earning workers), plotted as number of households by number of members. Data of the 55 studied farms for 1997 (blue columns) in comparison to 2017 (grey columns).

the 55 households in 1997 and still for 35 in 2017 (Table 2). In order to increment household incomes, over the last 20 years, a few of them have adopted on-farm diversification, running new activities such as direct production (e.g., olive oil mills and cheese production), direct selling (e.g., opening of butcher’s shops) or tourism activities (e.g., bed & breakfasts and restaurants). In particular, in 2017, nine households incremented their incomes by running agro-tourism activities. Moreover, some of them have diversified their revenue sources with off-farm activities, as school teachers, local shopkeepers or employees in the local municipality administration (Table 2).

4.2. Characteristics of animal husbandry

The animal species most frequently bred by the 55 study farmers are cattle, sheep and pigs (Table 3). In 1997, 16 out of the 55 farms bred cattle only, while they were just 14 in 2017. More often farmers practice mixed breeding, raising more than one species. Among the most frequent husbandry combinations, there are cattle plus sheep (1997: 8 farms; 2017: 5 farms), cattle plus pigs (1997: 9 farms; 2017: 5 farms), and all three species together (1997: 9 farms; 2017: 9 farms).

Cattle are predominantly raised for meat production, whereas in the case of sheep, farmers practice both meat and milk production.

Typically, the family-based farmers’ holdings raise relatively small numbers of animals. The farmers who stated that they breed cattle possessed 66 animals, on average (both in 1997 and 2017). The average number of sheep recorded was 97 and 71 animals per farm, in 1997 and 2017 respectively. The number of farmers stating they have 1–25 bovine animals was 10 in 1997 and increased to 21 in 2017 (Table 4); and similarly, sheep breeders with flocks counting 1–50 animals increased during the 20 year period from 11 to 21 (Table 5). These data suggest that there is a certain difficulty in the area in maintaining larger herds on farms, as they too-often rely on the work force of just a couple of elderly persons.

Table 2
Activities constituting the households’ income.

Types and composition of economic activities	Numbers of households	
	1997	2017
Animal husbandry exclusively	46	35
Animal husbandry plus activities related to breeding, production of meat and milk (multi-functional farms, on-farm diversification)	4	8
Animal husbandry plus off-farm labour	5	12
Total households	55	55

Table 3
Animal species raised by the 55 study farms.

Animal species	Number of farms	
	1997	2017
cattle	45	44
sheep	27	29
pigs (family use)	9	15
pigs (commercial use)	12	12
goats	7	10
horses and donkeys	5	19
farmyard animals (family use)	45	50

Table 4
Size of cattle herds.

Number of animals per herd	Number of cattle breeders	
	1997	2017
1–25	10	21
26–50	17	12
51–100	11	6
101–250	6	2
>250	1	3
Total breeders	45	44

Table 5
Size of sheep flocks.

Number of animals per flock	Number of sheep breeders	
	1997	2017
1–50	11	21
51–100	11	2
101–200	4	4
201–500	1	2
Total breeders	27	29

4.3. Damage to residential and farm buildings

Damage to residential buildings: The epicentre of the 1997 earthquake being situated quite close to the Assisano district, the study area was heavily struck in that occasion. The series of 2016–2017 earthquakes, in comparison, affected the area to a minor extent. Out of the 55 interviewed households, 48 reported that their residential homes had become inhabitable in 1997 compared to 10 in 2016. In 1997, most of the displaced people found accommodation in emergency wooden houses or modular structures (Table 6), other people stayed in hotels, with relatives or in undamaged dwellings in proximity to their damaged houses.

It is noteworthy that the few residential buildings that were not damaged by the 1997 earthquake had been rebuilt a few years earlier, i.e. after being hit by the 1984 earthquake.

Damage to farm buildings: Referring to the 1997 event, 39 out of the 55 farming households reported damage to one or more of their farm buildings, such as stables, barns and other agricultural annexes (Table 7). In 2016, 13 farm holdings had agricultural and animal husbandry buildings damaged.

It is noteworthy that among the stables not damaged in 1997 are

Table 6
Emergency accommodation of farm families, in 1997 and 2016 respectively.

Type of accommodation	1997	2016
Wooden houses, modular structures	25	2
Mobile home, caravan, barn	4	
Undamaged house in proximity	9	3
Hotel or relatives	10	5
Total families with inhabitable homes	48	10

Table 7
Damaged farm buildings after the 1997 and 2016 earthquakes.

Type of farm building damaged	Number of farms	
	1997	2016
Animal shelters (stables, sheds)	15	5
Agricultural buildings (haylofts, barns)	8	5
Animal shelters plus agricultural buildings	16	3
Households with damaged buildings (total under analysis)	39 (55)	13 (55)

those made of wood and delivered to farmers after the 1984 earthquake as emergency stables. Similarly, the same type of shelter that was provided to farmers after the 1997 earthquake (see Fig. 5 for some examples) withstood the 2016 earthquake and is still in use today.

Damage to people and animals: Fortunately, none of the last two earthquakes caused casualties within the 55 households under analysis; not a single case of an injured person or directly damaged animal has been reported. During the first emergency period after the strong 1997 earthquake, 31 out of 39 households had their stables officially declared as unusable. Some of them transferred their animals to other intact shelters within their own farm (9), on neighbouring farms or in structures made available by the municipality (7). A few of them decided to keep their animals on pasture (3) or resorted to putting up temporary shelters (2). However, a conspicuous proportion (namely 10 out of 31) continued to maintain their animals in damaged stables that had been officially declared as unusable.

4.4. Perception of disaster management

Asking farm household members from whom they have received major support during the emergency phase of the 1997 event, 19 of the 49 respondents mentioned public institutions, namely the Municipality Administration and the Government of Umbria Region, others stated they received major help from parents (8), or from both parents and the public (7). A significant proportion claimed that they had not received support from anyone (15 out of 49 in 1997; and 13 out of 16 in 2016).

4.5. The future of the reconstruction

Farmers' viewpoints on the future of their holdings: about half of the interviewees (26/55) perceived the future of their farms as endangered and an additional large share of them (24/55) did not feel able to give any answer to the question. Only 5 of them expressed a positive opinion. The majority (29/55) did not intend to modify anything of their farmer livelihoods, preferring "to stay as they are". The remaining 26/55 interviewees, however, expressed their willingness to invest in their farm holding, by launching new on-farm activities (17 cases), increasing the number of animals or activities already established (3 cases), or both (6 cases). Moreover, 13 farmers expressed the intention to invest in on-farm diversification related to the short food supply chain (such as

butchering, meat and milk processing and direct sales of meat, milk, salamis, sausages and cheese). Other respondents (6) would like to invest in hospitality structures like agritourism, guesthouses or B&B and 4 considered it more promising to invest in agricultural activities and cultivate cereals, grain, legumes or horticultural crops.

Farmers' viewpoints on the future of their communities: On the question "what are your feelings concerning the future of your community", a large part of the interviewees (34/53) expressed a distrustful view and many of them (13) were hesitant about giving any opinion ("I do not know"). Only 6 farmers appeared to look at the future in a more confident way. Major concerns expressed by the farmers regarded the limited profitability of animal husbandry activities but also the inadequate territorial infrastructure and poor public services provided by the public authorities to the rural communities. Moreover, they complained about a continuous increase of health and environmental regulations, obliging them to effect costly interventions or risk sanctions. According to farmers, these issues constitute important drivers for young people to leave the rural communities in search of more profitable employment and safer livelihoods in urban settings.

In order to contrast the above-mentioned problems, according to the farmers a more concrete public support should be given to farm holdings and the governmental institutions should display a more cooperative attitude towards farmers (Table 8). This request was made by 37 out of the 53 respondents (as first, second or third response) and related to the same topic, 33 interviewees asked for a general streamlining of administrative procedures.

Table 8
Requests to authorities to support farm holdings and rural communities.

Requested measures	First response	Second response	Third response	Total responses
Concrete support by governmental authorities, better collaboration of authorities with people	20	12	5	37
Streamline administrative procedures	13	17	3	33
Adopt policies to increase prices, incentives and funding in general	7	6	8	21
Create more and new job opportunities	4	4	9	17
Create conditions to favour the return of young people	6	4	5	15
Allocate more decision power to municipalities	2	2	5	9
Promote rural tourism	0	2	2	4
Promote local breeds, local products and organic practices	1	1	2	4
Total responses	53	48	39	140



Fig. 5. Examples of emergency wooden shelters provided after 1997 earthquake to farmers of Serravalle di Chienti (MC) municipality (close to the epicentre in Colfiorito) (photos taken by one of the authors)

5. Discussion

This study allowed the socio-economic characteristics of animal farm households of the Assisano district in the Umbria Region (Central Italy) to be illustrated, describing the damage of the 1997 and 2016 earthquakes to their residential houses and farm buildings. It also allowed vulnerabilities of the farming community to be discerned, possibly hampering hazard recovery and development of the area.

To provide more substantial evidence on the perception of the socioeconomic impact of seismic events in Central Italy, it was considered fruitful to discuss the results obtained in the Assisano district with those obtained from a similar survey, recently conducted by the same research team on the effects of the 2016 earthquake on livestock farms, involving 55 households in the Alto Maceratese area (in the Marche Region, Central Italy) [30].

Although situated rather close to the Assisano district (at a distance of about 50 km), the two study areas differ geographically. Whereas the Alto Maceratese farms are mostly located in a mountainous environment (>600 m a.s.l.), the farms of the Assisano study are in a hilly area (<500 m a.s.l.). For the cattle and sheep breeders of the Alto Maceratese, this entails a relatively shorter pasture season, less forage production and hence a relatively lower profitability of the pasture bound breeding activities.

Regarding socio-economic characteristics, in both areas, animal husbandry is mainly run as a family-based economic activity, hence remaining at a small scale. In 1997, the farm households included in the Assisano study consisted on average of 5.2 active members, with this number dropping to 3.3 in 2017, very similar to that assessed for the Alto Maceratese households (3.5) for the same year (2017). Data on the average age of heads of households complement the picture: in Assisano households it was 53.4 in 1997, 66.1 in 2017 and 58.0 in the Alto Maceratese households in 2017. These data indicate both a decrease and the ageing of the human capital in the animal husbandry sector which may have an impact on the sector's capacity of reacting to natural hazards.

In both study areas, a large share of farmers' households rely exclusively on the income earned from animal breeding and selling of un-processed products, i.e. meat and milk. This is the case for 46 and 35 out of the 55 Assisano households in 1997 and 2017 respectively; and for 27 out of 55 households in the Alto Maceratese (year 2017). In both settings a small number of farms have implemented on-farm diversification, by running activities such as bed & breakfast, restaurant, butcher's shop or cheese production, and off-farm diversification (e.g., school teachers, local shopkeepers or being employees in the municipality). This relatively weak on- and off-farm diversification of farmers' income may fuel the vulnerability of the farming community in the Assisano and Alto Maceratese and probably also in other rural and "inner areas" of Central Italy.

However, the fact that mixed breeding is rather diffuse in both areas may contribute to mitigating to some extent the economic impact of economic crisis and hazard aftermaths on farm holdings. In fact, in the Assisano area, farmers frequently breed cattle together with sheep or pigs or all three species together. Similarly, Alto Maceratese farmers more often keep cattle as well as sheep, whereas pigs are raised for domestic consumption only [30]. On the other hand, the relatively small number of animals raised by farmers is a relevant limit to the profitability of the activity. On average, breeders of the Assisano area rear 66 cattle and 71 sheep (2017 data) compared to 47 cattle and 287 sheep kept on average by Alto Maceratese breeders (2017 data). Moreover, in the Assisano study a decreasing trend of herd size has been observed over the last 20 years. The number of farms with 1–25 bovine animals was 10 in 1997 and increased to 21 in 2017. Similarly, sheep breeders with flocks counting 1–50 animals doubled during the 20 years period from 11 to 21. This reflects the difficulties of farming households to maintain larger herds given that they rely more often on the work force of just a couple of people. However, lack of human resources may not be

the only factor having negatively influenced the size of livestock holdings. Indeed, the agricultural sector has operated in unceasing uncertainty for many decades. Also as a consequence of climate change (e.g. more frequent spring and summer droughts), growing economic instability in general and an increasing volatility of agricultural markets (hence prices) have affected livestock activities. Thus, even in the absence of natural catastrophic events breeders and farmers have suffered from higher production costs, poorer returns, and little bargaining power with large retailers [31]. These may all have negatively influenced the size of livestock holdings, also in this region. Last but not least, damage to animal shelters caused by the earthquake in 1997 may have constrained some of those breeders who were not able to find alternative shelters to sell some of their animals.

In fact, the 1997 earthquake damaged the residential houses of 48 out of 55 study households and 39 farmers reported damaged stables, barns or other agricultural annexes. Comparable effects were found in the Alto Maceratese setting as a consequence of the sequence of tremors in 2016/2017 which damaged the residential houses of 40 out of 55 farmer's families interviewed and 56% of their farm buildings [30]. Although in most cases and in both settings emergency solutions were put in place during the months following the tremors (through public interventions or as private initiatives), the fact that due to complex administrative procedures reconstruction of the buildings has required years after the 1997 earthquake and appears to require a similar long time for the 2016/2017 earthquake, is a major inhibitory factor for the recovery of the animal husbandry sector and rural communities on the whole.

Nevertheless, a conspicuous number of farmers (26 out of 55 interviewees in the Assisano district and 20 out of 54 in the Alto Maceratese study) declared they are willing to invest in their holdings, by increasing the number of animals and/or by other types of on-farm diversification creating e.g. a butcher's shop (including production of salamis, raw ham and sausages), production of cheese and direct sale of milk products. Others would like to invest in tourism structures, such as agritourism, guesthouses or B&B. To realize such investments, interviewees in both studies called for major public support and better collaboration of the authorities with people. According to the farmers' point of view, funding opportunities provided by governmental structures are not adequate to ensure full recovery, as these are difficult and challenging to obtain. Administrative procedures need to be streamlined and more effective price policies should be adopted to effectively support farmers' households. From the interview study, a widespread perception emerged of the governmental structures as a distant body of power (farmers use the word "they" to refer to them). According to farmers, policy makers and public authorities are basically uninterested in the rural communities' fate. Moreover, it appears that this perspective has been further reinforced by the inexplicably slow path of reconstruction, after each of the earthquakes that struck these communities in the last decades. In response, several farmers expressed the opinion that greater power should be allocated to municipalities to bring programming and decision making on rural development closer to the communities. Thus, there is a willingness of farmers to contribute to decision making. However, a translation of this into a pro-active role as citizens appears to be demotivated by a perception of being part of an abandoned community and an ageing population at risk of extinction, a sentiment expressed by the frequently asked question "for whom should I contribute?"

Comparing the Assisano District with the Alto Maceratese confirms the existence of common open issues in both regions, with some specificities. Firstly, the Assisano district shows some traits of vulnerability, which emerged during the latest series of earthquakes. Although the Assisano district has not undergone a severe process of depopulation over the last two decades (see Fig. 2), this has been the case of the Alto Maceratese area, which has faced a steady process of economic marginalisation with an ageing population. This process is similar to the one observed in other inner areas across Italy [25].

This condition clearly represents a key driver of vulnerability, which can magnify the effects of an earthquake. Since the onset of the mass urbanisation process in the 1970s, rural and remote areas have been subjected to increasing socioeconomic weakening [32], which has enhanced their vulnerability to the recurrent natural hazards in the area [33]. Under these circumstances, an exogenous shock such as an earthquake is unlikely to act as a positive trigger, giving rise to an innovation process of governance, necessary for the take-off of sustainable development processes in the area. Given the current inadequate government assets, it is also unlikely that the inflow of external (financial) resources as a support for recovery and reconstruction can compensate for the negative effects of the earthquake [34]. Actually, if there are positive compensation effects, they will become manifest only in the long term, possibly in the next ten to twenty years. It must be recognized that these areas have been weakened so deeply by the socio-economic changes of the last decades that they will not be able to recover in the absence of proper interventions, supporting their economic and social development.

What is alarming is the drastic reduction in the number of economic agents in the affected territories. Not only farmers and their wage-earning workers have left - or are ready to leave - these areas, feeling that recovery is far from becoming a reality. Also young people in general are increasingly reluctant to remain and embrace the area as a place to earn their livelihoods. This begs the question as to whether the active population has dropped below the critical mass required for reconstructing and maintaining a vital socio-economic tissue in the area.

To this regard, it is worth mentioning the case of the L'Aquila area after the 2009 earthquake. Also in this case the small communities in the mountainous areas of Abruzzo have experienced a dramatic drop in the number of inhabitants, putting at risk the vitality of economic and social assets at municipality level [35].

6. Conclusions

This work has addressed the effects of large earthquakes on livestock activities in Central Italy, by comparing two different earthquakes (in 1997 and 2016) and two different areas (Umbria Region and Marche Region). The empirical analysis confirms the striking vulnerability of small scale, family-run livestock rearing in inner areas of Central Italy and appears to hint at the importance of holistic, forward-looking and evidence-based policy interventions rather than sectorial, improvised and scattered actions throughout the affected territories. The situation actually calls for drastic policy measures by national and regional governments, which should adopt a multi-sectoral approach to reconstruction, including - but not limited to - the economic assets. Firstly, a package of counter measures capable of halting any further population exodus should be put in place in the immediate future; and secondly community participation should prompt the development of local "building back better" initiatives [8,36].

"Building back better" initiatives are crucial to (re-)build safer buildings in the high earthquake hazard areas across Central Italy [8, 36]. This refers not only to residential buildings but also to industrial and farm premises, including also the related assets altogether essential for an economically sustainable development of these areas.

The prompt recovery of the Emilia area after the 2012 earthquake - which is considered as a best practice in Italy - did not happen by chance. The success was based on the capacity of the authorities and communities to promptly bring back into operation industrial as well as commercial premises in the affected area, hence implementing an immediate and effective response. Certainly, the socioeconomic contexts of the two areas are very different: the Apennines areas are rural, economically weak, and suffering from marginalisation, whereas Emilia is a densely populated and wealthy area, with a solid industrial fabric [37]. However, whatever the economic setting, the development of an area hit by an earthquake must resurge through the revival of its local economy. Taking the case of the Umbria and Marche Regions, the role of

the agro-food system is doubtlessly pivotal for their local economies and should therefore be recognized as a priority sector for regional and national investments.

Obviously, the aforementioned initiatives in the economic sector, despite being urgent and fundamental, cannot alone achieve recovery. Initiatives targeted at the recovery of human capital and of material and immaterial infrastructures (i.e., social capital in rural areas) should be included.

With regard to the recovery of material assets, most recent interventions by the Italian government address recovery of the Italian building stock. Economic incentives to private citizens have been issued for building renovations, namely by the "superbonus" scheme, foreseeing tax-breaks of up to 110% of the renovation costs (Decreto Legge Rilancio - DL 19 maggio 2020, n. 34 'Misure urgenti in materia di salute, sostegno al lavoro e all'economia, nonché di politiche sociali connesse all'emergenza epidemiologica da COVID-19' and the following modifications).

Any initiatives need to be embedded in policies adopted at a national level aimed at counterbalancing the processes of impoverishment in Italy and reducing social vulnerability [10-12], together with an array of measures supporting the creation and enhancement of specific competence networks across various domains (from structural engineers to energetic engineers, for example).⁴ In addition, initiatives designed for the inner areas of Central Italy are required to be coordinated with specific policies developed to tackle the issues of inner and remote areas in other parts of Italy [25].

Addressing this issue, in the Marche Region, after the 2016 earthquake, there was an immediate response to the extended devastation and suffering of the people by the academic community.⁵ However, these extensive discussions among researchers, politicians, public authorities and representatives of professional associations so far have been scarcely shared with the civil society at large. Thus, to verify that there is a sincere political consensus to rescue inner areas in general, the following steps are needed now to reactivate the reconstruction process:

1. a pro-active inclusion of civil society in the on-going debate in order to ensure that people's needs and aspirations are adequately considered in the 'building back better' process;
2. a debate on how to reorganize the present governmental and administrative assets to allow for a participated, science-based development of an integrated building back better programme and its prompt implementation.

It should be remembered that the developmental aims for the area can only be achieved by a holistic, concerted action; single, sectoral initiatives launched here and there cannot produce any significant progress. Worse, scattered and unplanned actions, conceived outside any serious medium-to-long-term planning risk, reinforce people's perception of being governed by a political elite not truly interested in their living and socioeconomic conditions.

⁴ A debate has been opened recently in Italy by the Department Casa Italia (Presidenza del Consiglio dei Ministri) with the support of the Research Center REDI (see the proceedings of the seminar "RISE - (Towards a) National Plan of Integrated Interventions for Seismic-Energy Enhancement of the Building Stock and Territorial Systems", Rome 27th October 2020, available at <http://www.re-di-research.eu/wp-content/uploads/2020/10/Atti-della-giornata-di-lavoro-RISE-Roma-27.10.2020.pdf>).

⁵ Two main contributions on the topic are titled "New Paths of Development" (*Nuovi sentieri di sviluppo*, available at: https://www.consiglio.marche.it/info/rmazione_e_comunicazione/publicazioni/quaderni/index.php) and "A Pact for Development" (*Patto per lo sviluppo*; <http://istao.it/patto-ricostruzione-sviluppo/>).

CRedit authorship contribution statement

Francesco Pagliacci: Conceptualization, Formal analysis, Methodology, Writing - original draft. **Cristina Luciani:** Investigation, Formal analysis. **Margherita Russo:** Conceptualization, Methodology, Writing - review & editing. **Fulvio Esposito:** Writing - review & editing. **Annette Habluetzel:** Conceptualization, Formal analysis, Methodology, Supervision, Writing - original draft.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Acknowledgments

The authors want to thank the veterinarians of the public health service USL Umbria 1 (Assisano district) and in particular Domenico Migliosi, Roberto Bigarini, and Elisabetta Pistidda, who facilitated the recruitment of the farmer participants. A special thanks goes to all the farmers who agreed to take part in the survey, spending their time on the interviews. The authors also thank the anonymous referees for their insightful comments.

References

- [1] G. Valensise, G. Tarabusi, E. Guidoboni, G. Ferrari, The forgotten vulnerability: a geology- and history-based approach for ranking the seismic risk of earthquake-prone communities of the Italian Apennines, *International Journal of Disaster Risk Reduction* 25 (2017) 289–300, <https://doi.org/10.1016/j.ijdrr.2017.09.014>.
- [2] European Commission, *Overview of Natural and Man-Made Disaster Risks the European Union May Face*. Commission Staff Working Document, Publications Office of the European Union, Luxembourg, 2017.
- [3] D. Sanders, J. Laing, W. Frost, Exploring the role and importance of post-disaster events in rural communities, *J. Rural Stud.* 41 (2015) 82–94.
- [4] J. Whittaker, K. Haynes, J. Handmer, J. McLennan, Community safety during the 2009 'Black Saturday' bushfire disaster: an analysis of household preparedness and response, *Int. J. Wildland Fire* 22 (6) (2013) 841–849.
- [5] A.M. Straub, B.J. Gray, L. Ashley Ritchie, D.A. Gill, Cultivating disaster resilience in rural Oklahoma: community disenfranchisement and relational aspects of social capital, *J. Rural Stud.* 73 (2020) 105–113.
- [6] B. Wisner, P. Blaikie, T. Cannon, I. Davis, *At Risk: Natural Hazards, People's Vulnerability, and Disasters*, Routledge, London, 2004.
- [7] UNISDR (United Nations International Strategy for Disaster Reduction), *Hyogo Framework for Action 2005–2015: Building the Resilience of Nations and Communities to Disasters*, United Nations, Geneva, 2005.
- [8] UNISDR (United Nations International Strategy for Disaster Reduction), *Sendai Framework for Disaster Risk Reduction 2015–2030*, United Nations, Geneva, 2015.
- [9] J. Birkmann, Risk and vulnerability indicators at different scales: applicability, usefulness and policy implications, *Environ. Hazards* 7 (2007) 20–31, <https://doi.org/10.1016/j.envhaz.2007.04.002>.
- [10] S.L. Cutter, B.J. Boruff, W.L. Shirley, Social vulnerability to environmental hazards, *Soc. Sci. Q.* 84 (2003) 242–261, <https://doi.org/10.1111/1540-6237.8402002>.
- [11] S.L. Cutter, L. Barnes, M. Berry, C. Burton, E. Evans, E. Tate, J. Webb, A place-based model for understanding community resilience to natural disasters, *Global Environ. Change* 18 (2008) 598–606, <https://doi.org/10.1016/j.gloenvcha.2008.07.013>.
- [12] S.L. Cutter, K.D. Ash, C.T. Emrich, The geographies of community disaster resilience, *Global Environ. Change* 29 (2014) 65–77, <https://doi.org/10.1016/j.gloenvcha.2014.08.005>.
- [13] D. Felsenstein, D.F. Shmueli, D.S.K. Thomas, Cascades - mapping the multi-disciplinary landscape in a post-pandemic world, *International Journal of Disaster Risk Reduction* 51 (2020) 101842, <https://doi.org/10.1016/j.ijdrr.2020.101842>.
- [14] I. Frigerio, M. De Amicis, Mapping social vulnerability to natural hazards in Italy: a suitable tool for risk mitigation strategies, *Environ. Sci. Pol.* 63 (2016) 187–196, <https://doi.org/10.1016/j.envsci.2016.06.001>.
- [15] F. Pagliacci, M. Russo, Be (and have) good neighbours! Factors of vulnerability in the case of multiple hazards, *Ecol. Indic.* 111 (2020), <https://doi.org/10.1016/j.ecolind.2019.105969>.
- [16] E. Cavallo, I. Noy, The economics of natural disasters – a survey, *International Review of Environmental and Resource Economics* 5 (1) (2011) 63–102, <https://doi.org/10.1561/101.00000039>.
- [17] S.E. Clarke, E. Chenoweth, The politics of vulnerability: constructing local performance regimes for homeland security, *Rev. Pol. Res.* 23 (2006) 95–114, <https://doi.org/10.1111/j.1541-1338.2006.00187.x>.
- [18] A.O.M. Bowman, B.M. Parsons, Vulnerability and resilience in local government: assessing the strength of performance regimes, *State Local Govern. Rev.* 41 (1) (2009) 13–24, <https://doi.org/10.1177/0160323X0904100102>.
- [19] S. Skerratt, Enhancing the analysis of rural community resilience: evidence from community land ownership, *J. Rural Stud.* 31 (2013) 36–46.
- [20] C.G. Ojeda, E. Jaque Castillo, Resilience is not a one-step process, in: *The Palgrave Handbook of Climate Resilient Societies*, Springer International Publishing, Cham, 2020, pp. 1–19, https://doi.org/10.1007/978-3-030-32811-5_71-1.
- [21] P. McManus, J. Walmsley, N. Argent, S. Baum, L. Bourke, J. Martin, B. Pritchard, T. Sorensen, Rural Community and Rural Resilience: what is important to farmers in keeping their country towns alive? *J. Rural Stud.* 28 (2012) 20–29.
- [22] S. Tarquini, I. Isola, M. Favalli, A. Battistini, TINITALY, a Digital Elevation Model of Italy with a 10 M-Cell Size, Istituto Nazionale di Geofisica e Vulcanologia (INGV), 2007, <https://doi.org/10.13127/TINITALY/1.0> [Data set], Version 1.0.
- [23] ISTAT, *Statistiche Istat*, Available at: <http://dati.istat.it/>, 2020.
- [24] A. Bagnasco, *Tre Italie: la problematica territoriale dello sviluppo italiano*, Studi e ricerche, Il Mulino, Bologna, 1977.
- [25] F. Barca, P. Casavola, S. Lucatelli, A strategy for inner areas in Italy: definition, objectives, tools and governance, *Materiali Uval Series* 31 (2014). Available at, http://old2018.agenziacoazione.gov.it/opencms/export/sites/dps/it/documentazione/servizi/materiali_uval/Documenti/MUVAL_31_Aree_interne_ENG.pdf.
- [26] P. Lowe, N. Ward, England's rural futures: a socio-geographical approach to scenarios analysis, *Reg. Stud.* 43 (2009) 1319–1332.
- [27] G. Myrdal, *Economic Theory and Underdeveloped Regions*. Methuen, University Paperbacks, London, 1957.
- [28] P. Boncio, G. Lavecchia, A structural model for active extension in Central Italy, *J. Geodyn.* 29 (3–5) (2000) 233–244.
- [29] M. Dolce, D. Di Bucci, The 2016–2017 central Apennines seismic sequence: analogies and differences with recent Italian earthquakes, in: K. Pitilakis (Ed.), *Recent Advances in Earthquake Engineering in Europe*. ECEE 2018. Geotechnical, Geological and Earthquake Engineering, vol. 46, Springer, Cham, 2018, https://doi.org/10.1007/978-3-319-75741-4_26.
- [30] A. Habluetzel, M. Russo, F. Pagliacci, L. Pacifici, C. Bisci, S. Casabianca, Effetti economici e sociali del sisma sugli allevamenti dell'Alto Maceratese. CAPPaper n. 161. Università di Modena e Reggio Emilia, 2018.
- [31] A. Habluetzel, F. Pagliacci, Sentieri di sviluppo nel settore agroalimentare e zootecnico, in: F. Esposito, M. Russo, M. Sargolini, L. Sartori, V. Virgili (Eds.), *Building Back Better: idee e percorsi per la costruzione di comunità resilienti*, Carocci Editore, Roma, 2017, pp. 128–135.
- [32] A. Copus, P.C. Melo, S. Kaup, G. Tagai, P. Artelaris, Regional poverty mapping in Europe – challenges, advances, benefits and limitations, *Local Econ.* 30 (2015) 742–764, <https://doi.org/10.1177/0269094215601958>.
- [33] F. Pagliacci, M. Russo, Multi-hazard, exposure and vulnerability in Italian municipalities, in: K. Borsekova, P. Nijkamp (Eds.), *Resilience and Urban Disasters: Surviving Cities: 175-198*, Edward Elgar Publishing, Cheltenham (UK), 2019.
- [34] P.S. Fisker, *Earthquakes and Economic Growth* (Working Paper No. 1/2012), Institute for Advanced Development Studies, La Paz, 2012.
- [35] C. Pesaresi, I comuni del cratere sismico, prima e dopo il terremoto del 2009. Considerazioni sui movimenti demografici in atto, *Semestrale di studi e ricerche di geografia XXIV* (1) (2012) 69–84.
- [36] F. Esposito, M. Russo, M. Sargolini, L. Sartori, V. Virgili (Eds.), *Building Back Better: idee e percorsi per la costruzione di comunità resilienti*, Carocci-Press online, 2017.
- [37] M. Russo, F. Pagliacci, Reconstruction after an earthquake: learning from the past the case study of Emilia-Romagna, *Scienze Reg.* 18 (2019) 523–530.